

REMARKS/ARGUMENTS

Claims 1, 3, and 5-47 are pending.

Claim 1 has been amended. Claim 1 comprises the limitations of the original claims 2 and 4.

Claims 40-49 have been added.

Claims 2 and 4 have been cancelled.

Support for the amendments is found in the claims and specification (e.g., 15, 16, 23, 24, 34), as originally filed. No new matter is believed to have been added.

Claims 1-3, 5-8, and 10-12 are under 35 U.S.C. 102(b) over Hibino et al., J. Chem. Soc. Faraday Trans., 91(13):1955-59 (1995), as evidenced by Arai et al., US 6,322,910. The rejection is traversed because:

(a) Hibino et al. do not describe micro-region reaction sites, and

(b) a working electrode layer to manage oxidation-reduction reactions is formed in the upper part of the cathode, and the micro reaction regions of nanometers to a micrometer in size where the oxidation-reduction reactions take place are introduced into the same layer (the limitation of the original claim 4, which was not rejected 35 U.S.C. 102(b) over Hibino et al.).

The claimed chemical reaction system efficiently excludes nitrogen oxides from exhaust gas containing oxygen. The system has micro reaction regions for performing oxidation and reduction reactions on a target substance introduced into a part of the chemical reaction so that oxygen and nitrogen oxides are separated and adsorbed from an exhaust gas within the micro reaction regions, thus allowing a target substance to be efficiently processed with low electric power consumption (see page 1 of the present specification).

The Hibino et al. electrochemical cell has a simple cell structure in which a zirconia electrolyte is sandwiched between an anode and a cathode of palladium. Therefore, substantial power is consumed by pumping oxygen that coexists in a gas to be treated.

As illustrated in Fig. 3, the cell must be supplied with a *large current*, e.g., as much as 500 mA/cm², for even decomposing 50% of NO_x.

The claimed chemical reactor system provides a selective decomposition reaction of NO_x molecules in coexisting oxygen by introducing nanoscale “micro-region reaction sites” for solving problems described in the present specification (e.g., does not require an excessive energy consumption) (see pages 3-10). The “micro reaction regions” is a structure having an interface comprising the three metal phases, an oxygen deficient part, and micro spaces (see claim 1, element (2))

Hibino et al. do not describe (a) micro-region reaction sites and (b) a working electrode layer to manage oxidation-reduction reactions is formed in the upper part of the cathode, and the micro reaction regions of nanometers to a micrometer in size where the oxidation-reduction reactions take place are introduced into the same layer (the limitation of the original claim 4 introduced in claim 1).

Thus, Hibino et al. do not do not anticipate the claimed reaction system.

Applicants request that the rejection be withdrawn.

Claim 4 is rejected under 35 U.S.C. 103(a) over Hibino et al., J. Chem. Soc. Faraday Trans., 91(13):1955-59 (1995), and Chandran et al., US 2002/0003085. The rejection is traversed because the combination of the references does not describe or suggest:

(a) micro-region reaction sites, and

(b) a working electrode layer to manage oxidation-reduction reactions is formed in the upper part of the cathode, and the micro reaction regions of nanometers to a micrometer in size where the oxidation-reduction reactions take place are introduced into the same layer.

The limitation of original claim 4 has been introduced in claim 1.

The disclosure of Hibino et al. is discussed above. Chandran et al do not cure the deficiency of Hibino et al.

The purpose in Chandran is to form other cathodes on a cathode, in an electrochemical cell for “increasing oxygen concentration” by oxygen pumping.

A conductive porous layer 54 of Pt is formed on the cathode 52 of Fig. 3. This structure enhances permeability of the gas to be treated because of porosity, and reduces the voltage drop by suppressing resistance because of the high conductivity of a Pt cathode (see page 3).

By contrast, the “micro-reaction regions” in the claimed reaction system are micro-reaction regions where oxidation-reduction reactions of a target substance take place, and interfaces consist of a metal phase - an oxygen deficient part - micro spaces at the points of contact between the electron conduction phase and the ion conduction phase (see claim 1). The micro-reaction regions are introduced into the cathode (see claim 3) and have a size of from a nanometer to a micrometer scale (see claim 1).

Therefore, even in the Hibino et al. single cell is supplemented with Chandran et al.’s overlapping cathodes, the combined structure provides an oxygen enrichment, while the claimed structure provides a selective decomposition of NO_x.

Also, the claimed micro-reaction regions comprise a metal phase, an oxygen deficient part and micro spaces that provide NO_x selective reaction sites, while the Chandran et al. structure adds a conductive porous electrode that provides an oxygen enrichment.

The effect of a selective reaction of NO_x in coexisting oxygen, which is the point of the invention of the present application, is the exact opposite of the purpose of the cathodes according to Chandran et al. providing an oxygen enrichment.

Thus, Chandran et al.'s cathode cannot accomplish the goal (promoting a reaction) of the claimed reaction system.

Accordingly, the combined system of Hibino et al. and Chandran et al. AND the "micro regions", oxygen-deficient parts, nanoparticles and gaps coexisting at a nanoscale of the claimed reaction system are different. Oxygen-deficient parts, nanoparticles and gaps coexist at a nanoscale are essential for the selective decomposition reaction of NO_x as micro-region reaction sites.

Thus, Hibino et al. and Chandran et al. do not make the claimed reaction system obvious.

Applicants request that the rejection be withdrawn.

Claims 9 and 13 are rejected under 35 U.S.C. 103(a) over Hibino et al., J. Chem. Soc. Faraday Trans., 91(13):1955-59 (1995), and Diekmann et al., US 6,268,076. The rejection is traversed because the combination of the references does not describe or suggest:

(a) micro-region reaction sites,

(b) a working electrode layer to manage oxidation-reduction reactions is formed in the upper part of the cathode, and the micro reaction regions of nanometers to a micrometer in size where the oxidation-reduction reactions take place are introduced into the same layer, and

(c) a barrier layer for suppressing ionization of coexisting oxygen in an exhaust gas

The disclosure of Hibino et al. is discussed above. Diekmann et al. do not cure the deficiency of Hibino et al.

The Examiner is of the opinion that including the Diekmann et al. barrier layer in the Hibino et al. reactor would have been obvious. Applicants respectfully disagree.

The Official Action (page 6) describes that Diekmann et al. states that a barrier layer is added to the cathode side to “vanishingly low electric conductivity, ensuring enough current between cathode and anode for electrochemical reaction (col. 2, lines 5-12).”

However, it is apparently incorrect. The passage in question describes adding Al_2O_3 to the barrier layer, as a countermeasure for tackling chromium volatilization, is problematic because electron conductivity drops dramatically as a result (through formation of an insulating layer).

The barrier layer in the claimed reaction system is a barrier layer for suppressing ionization of coexisting oxygen in an exhaust gas, while the barrier layer in Diekmann et al. prevents a drop in electron conductivity.

The purpose and function of the Diekmann et al. barrier layer is clearly different from that of the claimed barrier layer. It would not have been obvious to modify the Hibino et al. single cell with the barrier layer of Diekmann et al. to arrive to the claimed reaction structure.

Thus, Hibino et al. and Diekmann et al. do not make the claimed reaction system obvious.

Applicants request that the rejection be withdrawn.

A Notice of Allowance for all pending claims is requested.

Respectfully submitted,

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